Farmington, NH Wells #4 and #5 Drinking Water Treatment

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Introduction

Groundwater from Wells #4 and #5 of the Farmington Water System are experiencing elevated levels of iron (Fe), manganese (Mn), and Total Organic Carbon (TOC), as shown in Figures #1, #2, and #3. A pilot study was conducted by Blueleaf Inc, an independent pilot testing company, on the effectiveness of traditional oxidation filtration. The results were not adequate, due to the high concentrations of TOC present inhibiting the manganese removal process. Various treatment methods were researched to compile a viable treatment system for removing iron and manganese from high organic carbon sources. Critically, the system must be robust and simplistic to allow the operation staff of Farmington, NH to achieve and maintain consistent removals at a reasonable cost for a rural community.

Initial Water Quality

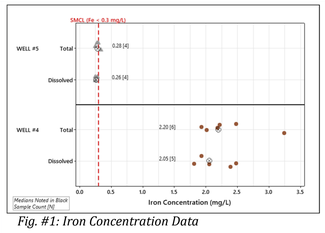

Fig. #1: Iron Concentration Data

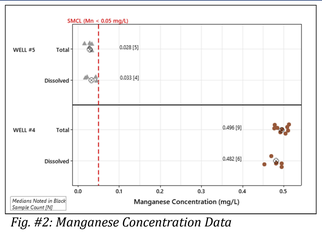

Fig. #2: Manganese Concentration Data

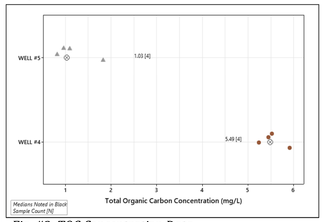

Fig. #3: TOC Concentration Data

Displayed in Figures #1, #2, and #3 are raw water sampling data points from Wells #4 and #5 in Farmington, NH. The concentrations in well #4 are above the secondary maximum contaminant limits (SMCL), shown with the dotted red line. Concentrations in Well #5 are much lower, but still at a level of concern.

Design Parameters

Table #1: Design Parameters and Targets

Contaminant of Interest	Treatment Processes	Design EBCT (Min)	Loading Rate (GPM/ft^2)	Vessel Configuration	Target DO (mg/l)	Target pH	Target Effluent (mg/l)
TOC @ 5.5 mg/l	Activated Carbon Contactor	10	3.25	3 in Series or Parallel	NA	NA	<2
Iron @ 2.2 mg/l	Anthracite Filtration	5	4.4	3 in Series or Parallel	>2-3	>7	<0.3
Manganese @ 0.5 mg/l	Biological Removal	12	2.5	3 in Series or Parallel	>4	>7	<0.05

Table #1 shows calculated and set design parameters, based on a design flow of 225 GPM from the wells. These parameters are based on the water quality in Well #4, as the system must be capable of treating the worse water quality. For effective removals, the iron, manganese and potentially TOC vessels will need periodic backwashing, utilizing clean process water.

Dover, NH Treatment Facility

Fig. #4: Calgon Activated Carbon Contactor

Fig. #5: Pudding Hill Treatment Facility

The Pudding Hill Water Treatment Facility in Dover, NH was studied to gain a more through understanding of how an iron and manganese Treatment Facility is designed and operated. The facility is currently under construction but is not yet operational. The contaminants of concern for the facility include PFAS, iron, manganese, MTBE and 1,4 Dioxane. The treatment processes in place to treat these contaminants are similar to proposed processes to treat the three contaminants of interest in Farmington, such as activated carbon and manganese dioxide coated media filtration.

Summary

To remediate the high levels of iron, manganese, and TOC found in the influent water, a plethora of treatment options were considered including chemical, physical, and biological alternatives. After further research and consultation of expert opinion, a treatment system utilizing both physical and biological processes was chosen. This configuration best satisfied the criteria and constraints proposed by the client, such as low operator involvement, high levels of effectiveness, a reasonable cost and reliability. By utilizing innovative biological manganese treatment, the system requires fewer chemical additions, less backwash water, and is overall a potentially more effective solution.

Proposed Process Flow Diagram

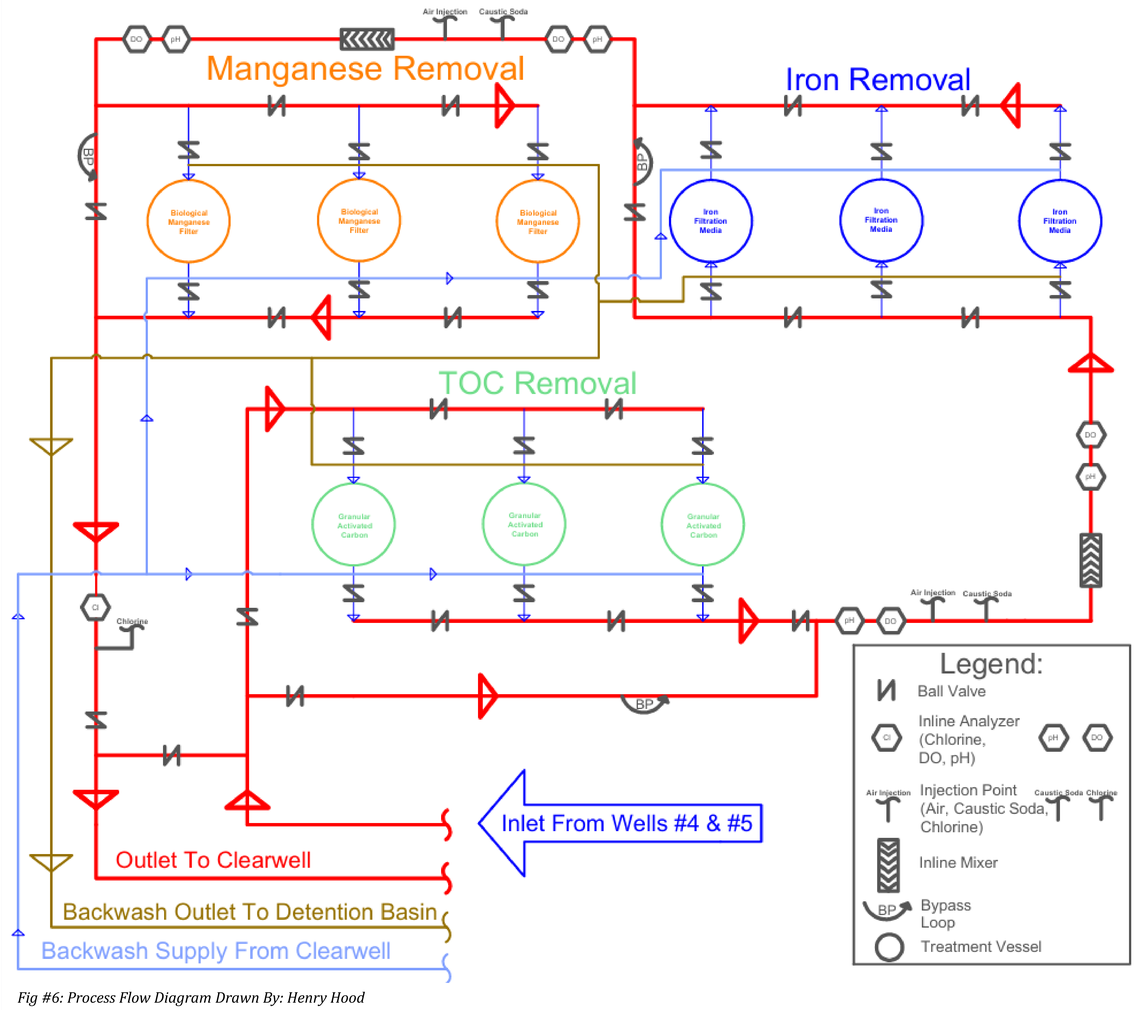

Fig #6: Process Flow Diagram Drawn By: Henry Hood

Results and Recommendations

Process Flow:

- Inline Monitoring
- Individual vessel and system bypass loops
- Triplicate vessels to create redundancy – 2 vessels capable of 100% flow
- Valving setup to operate in series or parallel depending on breakthrough rates
- Clearwell prior to distribution system supplies backwash

Pilot Study Recommendation:

This is a preliminary design; a pilot study should be conducted to determine:

- Ideal DO, and pH adjustment levels
- Vessel removals, ideal sizing and configuration
- Media loading rate or contact time for specific water quality
- Ideal filtration media types and microbial seeding strategies

Acknowledgements

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